

Global War on Hunger and Current Research on the Roles of World Entomologists in Enhancing Food Security

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ABSTRACT

The global war on hunger and the roles of world entomologists in enhancing food security were reviewed and the findings were highlighted for the attention of the International Community. The current state of affairs shows that hunger is prevalent in countries of the world marked by violence and internal discord and in countries compromised agriculturally, technologically, economically and politically. World hunger statistics revealed that the majority of hungry people live in developing countries where 12.9% of the population is grossly undernourished. Hunger was directly linked to global food crises and the most important factors responsible for the global food insecurity were high rate of population growth relative to agricultural productivity of a country, insect pest attack, low capacity to store food products, low capacity to buy staples from other sources, climate change, insurgency, impoverished health, political instability and high proclivity for corruption. The current Global Hunger Index scores revealed hunger inequalities in different countries of the world and showed that hunger has declined over the long term, but is still a serious problem. In the review, insects were identified as one of the perpetrators of the global food crises and their activities culminate in substantial economic losses. World entomologists have key roles to play in order to make global impact in the fight against hunger and the roles include developing methods for preventing the importation and spread of destructive insects, embarking on extensive studies on the role of insects in agriculture, forestry, human and environmental health, designing and implementing pest management programmes for both urban and agricultural locations, coordinating public awareness and education programmes targeted at reducing hunger, discovering and cataloguing new species and classifying and preparing publications that help to identify different insect species, and being actively involved in pest control services and extension programmes. These functional responsibilities will help to control insect pest attacks and reduce hunger by increasing agricultural productivity.

Keywords: World entomologists, Hunger statistics, Global food crises, Losses, Agriculture.

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INTRODUCTION

Hunger has been described by many, as a subjective feeling of discomfort which follows a period without eating. Global Hunger Index GHI (2004) described hunger as the distress associated with lack of food and the state of total food deprivation and undernourishment. According to Food and Agricultural Organization of the

United Nations FAO (2014), there is hunger when a person's food consumption is below the minimum of 1,800 kcal/day required for a healthy and productive living. It is already known that this compelling desire for food described as hunger can occur at various levels in society. Namely, an individual, household, nation,

continent or even the entire globe can battle with hunger. Hunger is one desire which every living thing including man wishes to satisfy in a hurry. When prolonged, the body system usually ends up in a crisis.

Hunger has received increased attention and world hunger statistics (www.foodaidfoundation.org/world-hunger-statistics.html) shows that (i) some 795 million people in the world do not have enough food to lead a healthy active life; this is about one in nine persons on earth, (ii) the majority of the world's hungry people live in developing countries, where 12.9% of the population is undernourished, (iii) sub-Saharan Africa is the region with the highest prevalence of hunger; one person in four in sub-Saharan Africa is undernourished, (iv) poor nutrition causes nearly half (45%) of deaths in children under five- 3.1 million children each year, (v) one out of six children (roughly 100 million) in developing countries is underweight, (vi) one in four of the world's children are stunted; in developing countries the proportion can rise to one in three, (vii) If women farmers had the same access to resources as men, the number of hungry people in the world could be reduced by up to 150 million, (ix) sixty-six million primary school-age children attend classes while hungry across the developing world, with 23 million in Africa alone, (x) the world Food Programmed calculates that US\$3.2 billion is needed per year to reach all 66 million hungry school-age children and so the war requires commitment. Hunger can be acute, chronic or hidden depending on the magnitude with acute hunger representing 10% when the lack of access to adequate food is for a short-term possibly due to drought or war and 90% in chronically undernourished situations (Food and Agricultural Organization of the United Nations FAO, 2003; United Nations Millennium Project, 2005). Hunger and global food crises are partners, the latter dragging the former. Global food crises or global food insecurity exists when people are undernourished because of physical unavailability of food, lack of access to and/or inability to utilize food effectively due to infection or disease (Federal Ministry of Agriculture and Water Resources FMAWR, 2008). According to Adedire (2011), the main factors responsible for global food crises are a high rate of population growth relative to the agricultural productivity of a country, low capacity to store excess food produced, low capacity to purchase staples from other sources and political volatility. It is known that about 14% of all food production is destroyed by insect pests, despite serious control with synthetic chemicals (Pimentel, 2007; Gemechu et al., 2011) and this implies that the arthropod is a major cause of hunger. Berebaum (1995) reported that virtually all crops in Africa are exposed to insect pest attack to some degree.

This has made the role of insect pests very important in food production. Adedire (2011) reported that insects are into very serious contention with man and are the most

probable originator of the global food crises. Their activities culminate in substantial economic losses. Therefore, it is incontrovertible that in tackling hunger, world entomologists have a key role to play and it centres on insects. Unfortunately, the roles Entomologists play in tackling the damaging activities of insects in agriculture have been grossly understudied and implemented. This research gap is one of the features which the present work hopes to bridge. It has been reported that after several years of combating malnutrition, the number of hunger victims is likely to increase (Powledge, 2010) and this has come to fulfilment evidenced by widespread hunger and poverty currently affecting many countries. From current analysis (Peng and Berry, 2018), the future does not look very promising due to the expanding world population. Deadlines to control hunger have reached and passed and policymakers rely on scientific research for progress. In other words, both policymakers and researchers have important roles to play in tackling this quandary.

In the present review, we reveal the feasible roles world Entomologists can play in order to help solve the dilemma. Full implementation of suggested entomological actions will enhance food security by fighting the insects (originator of food crises) successfully. Insects belong to the great phylum of the animal kingdom called Arthropoda which are marked by the possession of an exoskeleton which serves as coverage to inner organs and as a receptor of stimuli. Insects account for more than three-quarters of all known animals and are frequently regarded as pests and seldom as beneficial organism. As a result, even the useful insects are unfairly oppressed. Insects exist in enormous numbers and being small; they colonize areas expediently. Notably, insects are numerous mainly because they show high fecundity and their high number and diversity has both positive and negative effects on hunger. The main aim of applied entomology is to manipulate both injurious and beneficial insects to man's advantage and successful manipulation depends largely on the possession of adequate knowledge of insect biology. Although insects are generally viewed as destructive organisms by man, they play an important role in the production of industrial and medicinal products and are critical in cultural entomology. Other indispensable roles insects play include pollination of cultivated and non-cultivated plants, serving as a food resource for both man and other animals and disposing of dead organisms through recycling and restoration of ecological balance. Many insects are vectors of diseases and some are crop or livestock pests. As pests, insects are man's commonest enemy at home or on the farm since they attack stored products, livestock and agricultural crops (Ayertey, 2002; Lale, 2002; Umeozor, 2009; Ajayi, 2015). Damage to stored products due to insect attack serve as portals of entry for weakly

pathogenic organisms and this is totally unfair to man who depends on his stores for many reasons especially to cope with hunger. To considerably reduce hunger in the world therefore, entomologists are well-equipped to control insects as pests and vectors of disease pathogens and manipulate beneficial species to improve the livelihood of man using various techniques. Of course, the overall action should ensure food security in order to meaningfully reduce hunger globally.

The United Nations Environment Programme UNEP (2002) and International Federation of Red Cross and Red Crescent Societies IFRCRCS (2009) classified three dimensions of food security as (i) food availability which refers to a situation in a local area, region or country where such food is physically available either because it has been grown, processed manufactured and/or imported, (ii) food access which refers to the way in which different people acquire available food which may include home production, use of left-over stocks, purchase, barter, borrowing, sharing, gifts from friends and relations and/or through provision by welfare system or food aid, and (iii) food utilization which refers to the way in which people use food and this depends on a number of factors such as quality of food and its method of preparation, storage facilities, nutritional knowledge and health status of the consumer. In fact, any action by world entomologists that ensures the availability of nutritious food at all times to all people is necessary for the global war against hunger. Food is a major means of sustaining life and its adequate intake (to meet specified criteria of adequacy and prevent the risk of deficit or excess) in the right proportion (both quantitatively and qualitatively) is considered as a key to healthy living and productive wellbeing (Lale, 2012). Food accounts for a substantial budget of households (Omonona and Agoi, 2007). Daily minimum nutrient for an adult is put at 65 g protein and 2500 kcal of energy per capita intake and any shortfall, lead to malnutrition (World Health Organization/ Food and Agricultural Organization of the United Nations FAO, 1993). International Federation of Red Cross and Red Crescent Societies IFRCRCS (2009) reported that sub-Saharan Africa is not on track to achieve the food-related millennium development goal and therefore the continent is vulnerable to high malnutrition levels. Lale (2012) attributed this state of affairs to food insecurity in the place coupled with numerous problems such as HIV/AIDS, climate change, insurgency, environmental degradation deficiencies, disproportionate population of humans, poor economic growth and governance. This resulted in a significant decline in agricultural production especially with rural-urban migration, increased population below the poverty line and chronic food insecurity in the region where agriculture accounts for 35% of the Gross Domestic Product. World Food Programme WFP (2009) estimated that 40% of people in sub-Saharan Africa live below the poverty line, with the

daily increase in both income and human poverty and yet they spend over 60% of their earnings on food. The United Nations Environment Programme UNEP (2002) reported that none of the African countries is included in the list of the high Human Development Index- which is a measure of the quality of life; rather they were all ranked among the low Human Development Index. The United Nations Environment Programme UNEP (2002) however, forecasted that human susceptibility in Africa is most likely to rise thus leading to increased poverty and wretchedness and rapid decline in the environmental quality of the continent. Food production in sub-Saharan Africa grew at 1.5% per annum while the population grew at 3% from 1970 to 1985 since then; the situation has continued to deteriorate. From 1988 to 19993, 33 African countries experienced a reduction in per capita food production (Rosegrant et al., 1997). McGranaham et al. (1999) extrapolated that by the 2025 Africa's food demand will sharply increase and in order to realize food security, grain production needs to increase by four times and animal production by seven times. The United Nations Environment Programme UNEP/ the United Nations Conference on Trade and Development UNCTAD (2008) in a joint report stated that over the past 40 years, globally there has been a remarkable increase in per capita world food production 17%, which translated to 145% aggregate world food production increase. From the 1960s to 1990s average cereal yield grew from 1.2 t/ha to 2.25t/ha in developing countries and a total cereal grew from 420t/ha to 1,176 million t/ha per year (Food and Agricultural Organization of the United Nations FAO, 1996). The reverse case is the Rivers State in Nigeria, Africa where food production per person is 10% lower today than in 1960 (United Nations Environment Programme UNEP/ United Nations Conference on Trade and Development UNCTAD, 2008). Lale (2012) reported that the recent advance in science and technology has not led to proportionate increase in food production nor adequate access to food in the African continent.

The author stated that in sub-Saharan Africa, the number of hungry people has increased by 20% since 1990. United Nations/System Standing Committee on Nutrition UN/SCN (2004) and Von Braun (2005) have extrapolated that from the year 2000 to 2002, proportion of undernourished people in the total population in Kenya was 33%, Uganda, 19%, Tanzania 44% with the number of underweight children increasing in Central, West and East Africa while the figure decreased in developed nations of the world. Only Asia and Africa remained vulnerable to hunger. Researchers believe that the combination of increased production techniques and imports to food deficit countries will mean increase in per capita consumption by 2015 a person living in developing country will still consume only half of the cereals and a third of the animal protein consumed by a person in an industrialized country (Pretty and Hine, 2001; Von Braun,

Table 1. Global hunger index (GHI) severity scale for interpretation of Table 2.

S/N	GHI	Implication
1	≤9.9	Low
2	10.0 – 19.9	Moderate
3	20.0 – 34.9	Serious
4	35.0 – 49.9	Alarming
5	≥50.0	Extremely alarming

Source: IFPRI (2017).

2005; Lale 2012). In Nigeria, Nwajiuba (2012) reported that at present Nigeria is facing huge food security issues with over 70% of the population living in less than 100 Naira (US\$0.035) per day. Therefore, majority of Nigerians are hungry, impoverished, wretched and angry and the question is, what can world entomologists do to assist the people of the world that are battled with hunger. In this paper, we have highlighted our findings based on the literature reviewed.

GLOBAL HUNGER INDEX: CURRENT DATA AND TRENDS

Global hunger index (GHI) has the capacity to holistically measure and track hunger at the global, regional and national levels (Wiesmann, 2006). The GHI is based on four very important indicators namely, undernourishment, child wasting (low weight-for-height), child stunting (low height-for-age) and child mortality. These indicators reflect caloric deficiencies and poor nutrition. The GHI not only covers nutrition status of the entire population but also of children. Children are particularly vulnerable that lack of dietary energy, protein, essential vitamins and minerals cause them high risk of illness, poor physical and cognitive development, and death. Table 1 is a scale which shows the severity of hunger from low to extremely alarming hunger, associated with global hunger index scores. Table 2 shows the global hunger index scores by rank from 2000 to 2017 and revealed the hunger inequalities and hunger performance ranks in different countries of the world. The 2017 global hunger index revealed that hunger levels and under-nutrition have diminished over the period covered. Countries with high rate of population growth relative to agricultural productivity, heavy insect pest infestations, low capacity to store food products, low capacity to buy staples from other sources, bad climate change effects, war and insurgency, poor health, political instability and high propensity for corruption are most likely to have high global hunger index. Figure 1 shows the 2017 global hunger index and revealed the trend and progress since 2000. Countries which experienced a higher reduction in hunger, lower reduction in hunger and an increase in hunger from 2000 to 2017 have been indicated in Figure 1.

The Figure illustrates the changes in global hunger index scores in absolute values. It featured countries where data were available to calculate 2000 and 2017 global hunger index scores and where 2017 global hunger index scores show moderate, serious, alarming, or extremely alarming hunger levels. Some likely poor performers may not have appeared due to missing data. According to literature, the 2017 global hunger index scores similarly revealed a decline both in hunger and under-nutrition (International Food Policy Research Institute IFPRI, 2017). Briefly, the average GHI score for the year 2017 is 27% lower than the year 2000 score (29.9%). This improvement reflects the decline in each of the global hunger index indicators since 2000 (International Food Policy Research Institute IFPRI, 2017). Details of the 2017 GHI show that the proportion of the population that is under-nourished is down from 18.2% in 1999 to 2001 to 13.0% as at 2014 to 2016. Furthermore, the records show that 27.8% of children under age five were stunted while 9.5% were wasted. Meanwhile, the mortality rate diminished from 8.2% in 2000 to 4.7% in 2015. Despite these improvements, a number of factors including deep and repetitive inequalities globally weaken efforts to end hunger and under-nutrition. Part of the consequences is that although the mean global hunger level has reduced, some regions of the world still battle with hunger more acutely than poorer or more vulnerable neighbours.

The United Nations (in early 2017) announced that at least 20 million people were at risk of extreme shortage of food in four countries of the world namely, Nigeria, Somalia, South Sudan and Yemen. It is pathetic to note that these crises are caused by man, precisely as a consequence of greed, violent contention and internal discord that prevent people from having access to food and clean water while sabotaging aid organizations to a magnitude that reaching people in need become practically impossible. However, it is pertinent to mention that the GHI scores for 2017 were not reported for thirteen countries of the world because data on under-nutrition and in some cases data on child stunting and child wasting were not available. Incidentally, the countries with missing data may not be the most affected. Out of the thirteen countries, nine had insufficient data, yet major concerns (International Food Policy Research Institute IFPRI, 2017). Table 3 presents the nine

Table 2. Global hunger index (GHI) scores by rank 2000 to 2017.

Rank	Country	2000	2005	2010	2017	Rank	Country	2000	2005	2010	2017
2017 GHI scores less than 5, collectively ranked 1 to 15	Belarus	5	<5	<5	<5	62	Ghana	29	22.2	18.2	15.2
	Bosnia and Herzegovina	9.8	7.2	5.1	<5	63	Gabon	21.1	19	16.7	15.4
	Chile	<5	<5	<5	<5	64	Viet Nam	28.2	23.8	18.8	16
	Costa Rica	6.1	5.6	5.0	<5	65	Bolivia	30.3	27.1	21.8	16.7
	Croatia	6.2	<5	<5	<5	66	Senegal	37.3	27.8	24.1	17.2
	Cuba	5.3	<5	<5	<5	67	Sri Lanka	22.3	21.2	17.9	17.9
	Estonia	6.7	5.4	<5	<5	68	Myanmar	44.4	36.4	25.9	20.1
	Kuwait	<5	<5	<5	<5	69	Philippines	25.9	21.6	20.6	20.2
	Latvia	6.9	5.0	<5	<5	70	Guatemala	27.5	23.8	22	20.8
	Lithuania	5.0	<5	<5	<5	71	Cameroon	41.2	33.7	26.1	21.1
	Montenegro	—	—	<5	<5	72	Nepal	36.8	31.4	24.5	21.2
	Romania	8.3	6.8	6.1	<5	73	Indonesia	25.5	26.5	24.5	21.9
	Turkey	10.3	7.3	5.3	<5	74	Iraq	26.5	24.9	24.4	22.1
	Ukraine	13.6	5.0	<5	<5	75	Gambia	27.3	26.2	22.3	22.3
	Uruguay	7.7	8.1	5.4	<5	76	Swaziland	28.9	27.6	26.7	22.5
16	Bulgaria	8.2	7.8	7	5	77	Kenya	36.5	33.5	28	23.2
16	Slovak Republic	7.2	6.8	5.8	5	78	Cambodia	43.5	29.6	27.8	23.7
18	Argentina	6.7	6.2	5.9	5.3	78	Lesotho	32.5	29.7	26.3	23.7
19	Kazakhstan	11.3	12.4	8.8	5.5	80	Benin	37.5	33.5	28.1	24.3
20	Macedonia, FYR	7.7	8.5	7	5.9	80	Namibia	30.6	28.4	30.9	24.3
21	Russian Federation	10.1	7.7	7	6.1	80	Togo	39.1	36.4	27.1	24.3
22	Mexico	10.8	9.1	7.7	6.5	83	Lao PDR	48	35.8	30.3	25.3
22	Serbia	—	—	6.7	6.5	84	Botswana	33.1	31.2	28.4	25.5
24	Iran	13.5	9.4	8.1	7.3	85	Côte d'Ivoire	33.7	34.7	31	25.9
25	Armenia	18.4	12.8	11.3	7.6	86	Bangladesh	36	30.8	30.3	26.1
25	China	15.8	13	10	7.6	87	Malawi	44.7	37.8	31.4	26.5
27	Colombia	11.3	10.8	10	7.7	88	Mauritania	33.5	29.7	24.8	27.3
28	Tunisia	10.7	8.6	7.6	7.9	89	Burkina Faso	47.4	48.8	36.8	27.7
29	Trinidad and Tobago	11.7	12.2	12.2	8	90	Mali	44.2	38.7	27.5	27.8
30	Georgia	14.6	10.5	8.4	8.1	91	Rwanda	58.1	44.8	32.9	28.7
31	Brazil	13	7	6.6	8.5	92	Guinea	43.7	36.8	30.9	28.9
31	Paraguay	13.9	12.5	11.4	8.5	93	Ethiopia	55.9	45.9	37.2	29.1
31	Saudi Arabia	11.5	13.8	9.7	8.5	93	Guinea-Bissau	42.4	40.3	31	29.1
34	Jamaica	8.4	8.2	8.5	8.6	95	Angola	65.6	50.2	39.7	29.5
35	Peru	20.9	18.4	12.5	8.8	95	Tanzania	42.4	35.8	34.1	29.5
36	Fiji	9.8	9.3	8.6	9	97	Papua New Guinea	30.9	28.2	34.3	29.7
37	Panama	19.8	17.7	12.6	9.1	98	Djibouti	46.7	44.1	36.5	30.1
38	Kyrgyz Republic	18.8	14	12.4	9.3	99	Congo, Rep.	37.8	37.2	32.2	30.4
39	Algeria	15.6	12.9	10.6	9.4	99	Niger	52.5	42.6	36.5	30.4
40	Azerbaijan	27.4	17.4	12.3	9.5	101	Comoros	38	33.6	30.4	30.8
41	El Salvador	16.3	13.3	12.8	10.1	102	Mozambique	49.1	42.4	35.8	30.9
42	Suriname	16	12.5	10.5	10.2	103	India	38.8	38.8	32.2	31.1
43	Dominican Republic	18.4	17.2	13	10.3	103	Nigeria	40.9	34.8	29.2	31.1
44	Morocco	15.7	17.8	10.2	10.4	105	Uganda	41.2	34.2	31.3	31.2
44	Thailand	18.3	13.3	12.9	10.4	106	Pakistan	38.3	37	36	32.6
46	Oman	13.7	14.7	9.8	10.8	107	Zimbabwe	38.7	39.7	36	32.9
47	Mauritius	15.9	15.2	14.1	11	108	Liberia	48.4	42	35.2	33.3
48	Jordan	12.2	8.5	8.3	11.2	109	North Korea	40.3	32.9	30.9	34
49	Venezuela	15.2	12.7	8.4	11.4	110	Timor-Leste	—	41.8	42.4	34.2
50	Lebanon	9.1	10.3	8	11.7	111	Afghanistan	52.3	43.2	35	34.3
51	Ecuador	20.6	17.6	14.1	11.8	112	Sudan	—	—	—	34.8
52	Uzbekistan	23.7	17.9	15.6	12.1	113	Haiti	42.7	45.2	48.5	35.4
53	Albania	21.6	16.9	15.4	12.2	114	Sierra Leone	54.4	51.7	40.4	35.7
53	Turkmenistan	22	17.4	15.3	12.2	115	Zambia	52	45.8	42.8	37.6
55	Guyana	17.8	16.9	15.9	12.6	116	Madagascar	43.5	43.4	36.1	38

Table 2: contd.

55	Mongolia	31.7	24.9	15.8	12.6	117	Yemen	43.2	41.7	34.5	39.7
57	Malaysia	15.5	13	11.9	13.3	118	Chad	51.4	52	48.9	45.4
58	Nicaragua	24.7	17.8	16.4	13.6	119	Central African Republic	50.5	49.6	41.3	53.7
59	Honduras	20.6	17.7	14.7	14.4						
60	South Africa	18.1	20.8	16.1	14.5						
61	Egypt	16.4	14.3	16.3	14.8						

The 15 countries with 2017 GHI scores of less than 5 are not assigned individual ranks, but rather are collectively ranked 1 to 15. Differences between their scores are minimal. Ranked according to 2017 GHI scores, countries that have identical 2017 scores are given the same ranking (for example, Bulgaria and the Slovak Republic are both ranked 16th. Source: IFPRI (2017).

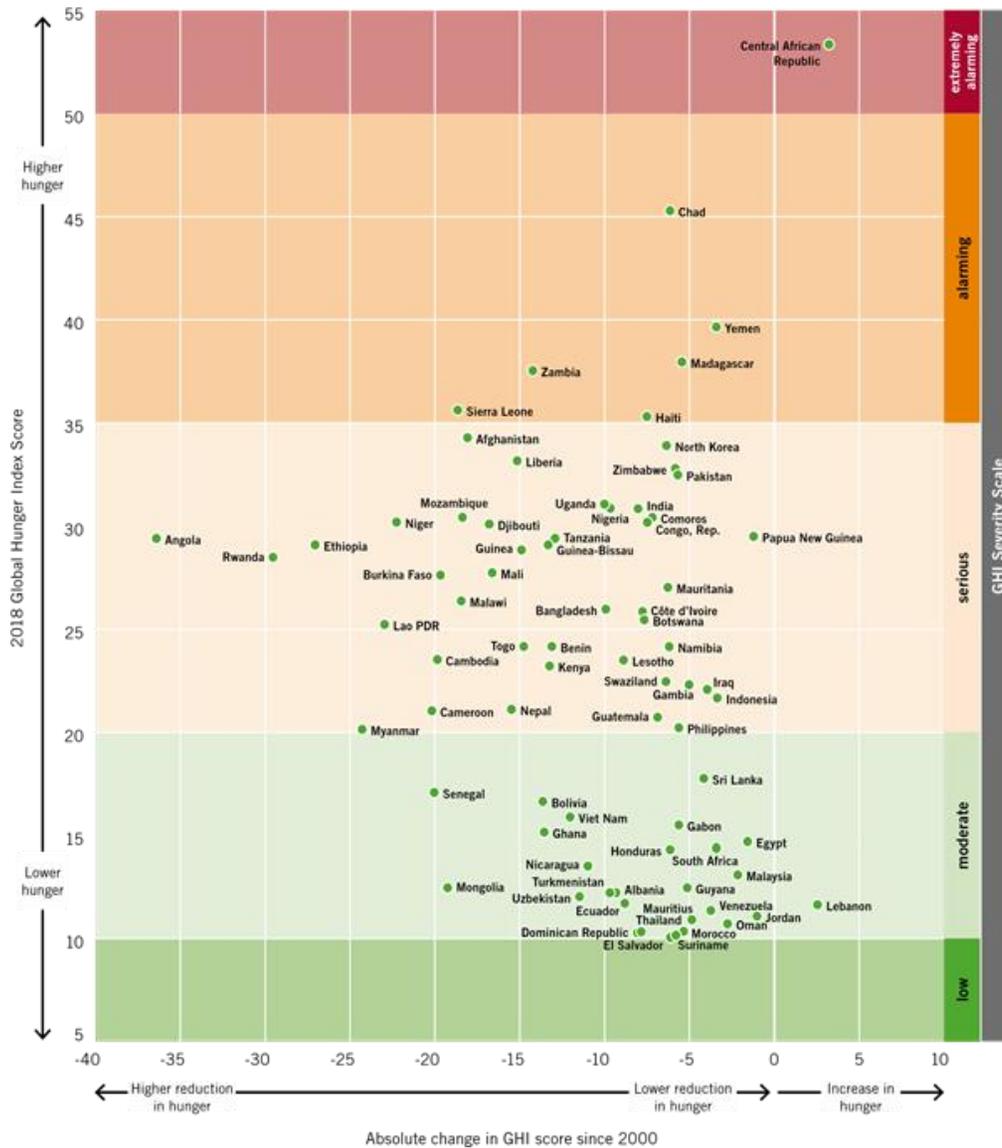


Figure 1. The 2017 global hunger index (GHI) scores and progress since the year 2000. Source: IFPRI (2017).

countries and the existing GHI indicator values. Child stunting level in Burundi (56.6%) was highest. This tallied

with the report of von Grebmer et al. (2014) which placed Burundi in the extremely alarming moderate hunger category when

Table 3. Existing global hunger index indicator values in nine countries with insufficient data yet significant concerns.

S/N	Country	Child stunting in children under five 2012 to 2016 (%)	Child wasting in children under five 2012 to 2016 (%)	Under-five mortality 2015 (%)
1	Burundi	56.6*	7.6*	8.2
2	Comoros	32.1	11.1	7.4
3	Congo, Democratic Republic	42.6	8.1	9.8
4	Eritrea	53.3*	14.7*	4.7
5	Libya	25.9*	5.8*	1.3
6	Papua New Guinea	41.5*	7.1*	5.7
7	Somalia	-	-	13.7
8	South Sudan	36.9*	27.3*	9.3
9	Syrian Arab Republic	-	-	1.3

Source: IFPRI (2017). * indicates IFPRI estimates; - indicates not available. Note that under-nourishment values are not available for countries in this table.

all data were available to calculate full global hunger index scores in 2014. The factors responsible for Burundi's food crises are not different from those already highlighted. In fact, twelve years of violent contention and internal strife (1993-2005) contributed to Burundi's food insecurity and impoverished nutrition (World Food Programme WFP, 2015). Prevalence of under-nutrition in children is extreme in Eritrea (Table 3). Under-nutrition in Eritrea is directly related to the challenges of food production due to limited arable land, water shortages and frequent droughts. People's ability to purchase food is also limited by extreme poverty (United Nations International Children's Emergency Fund UNICEF, 2015) and this may have also affected Eritrea. Table 3 further shows that Somalia had the highest child mortality (13.7%) in 2017 and child mortality is the only global hunger index indicator for which data were available for Somalia. Persistent drought, indiscriminate internal displacement of individuals and a series of frustration providing humanitarian services to Somalia population brought the country to the threshold of famine. In 2011, famine wasted 250,000 lives in Somalia (World Food Programme WFP, 2015). The 13.7% child mortality recorded in Somalia in 2017 is the third highest rate of child mortality among the countries captured in this review. Conclusively based on available data, Burundi, Eritrea and Somalia have high global hunger index suggesting high-level hunger and wretchedness in the countries.

LOSSES CAUSED BY INSECTS AND ROLE OF ENTOMOLOGISTS IN FIGHTING SUCH LOSSES IN AGRICULTURE

Loss is a measurable decrease in foodstuff, which may be qualitative or quantitative. Therefore, loss leads to hunger. Lale and Ofuya (2001) and Lale (2002) categorized loss in agricultural products attributed to insect pest in storage depending on the kind of damage and the crop product as:

i. Loss in weight when insect feed on stored commodities especially the endosperm and cotyledons thus amounting to a reduction in wholesome weight of the grain and edible seeds.

ii. Loss in quality mostly arising from infestation of cereal and grain legume by arthropod pests thereby resulting in loss of vital nutrients to some extent the alteration of the chemical structures of the nutrients is not uncommon and sometimes the industrial values as well.

iii. Loss in visual appeal and market value. When arthropod pests leave their broken body parts such as antenna, legs and wings, or their dejecta and debris amidst commodities, loss in visual appeal of such commodities often occur. Others include physical damage of grains (such as the presence of holes) and discoloration of the products which all reduce the market value of affected commodities.

iv. Indirect loss by microflora especially in humid areas. Arthropods infestations lead to microfloral growth and thus result in caking of grains and indirect loss.

v. Reduction in nutritional value and seed viability. Insects mostly attack the embryo of seeds because it is the most nutritious component. This, however, results in loss of essential nutrients and loss of viability. Loss of agricultural products due to insect pests started right from when man began to grow crops and store the products for future use. Swaminathan (1981) reported that crop cultivation may have begun over 10,000 years back by women while their male counterparts engaged in hunting (Ayertey, 2002).

The major challenge even at that time was insect pest infestation and disease epidemics which probably arouse from monoculture of few crops. For instance, in Africa, *Schistocerca gregaria* carvings could be found on tombs of dating 2470-2220BC which was also recorded as a catastrophe pest in Exodus 10:1-15 (written 1300BC) and also in the tomb of Tutenkhamum around 1350BC, storage insects such as *Lasioderma serricorne*, *Oryzaephilus surinamensis*, *Rhizopertha dominica* and *Tribolium castaneum* were identified (Ayertey, 2002). United Nations general Assembly at its 7th special

session in 1975 passed a resolution that 'no child, woman or man should go to bed hungry and no human being with physical or mental potentials should be stunted by malnutrition'. This call was made to urge member nations to reduce post-harvest losses by 50% within ten years (that is, by 1985). It is evident that there are more people going to bed hungry despite the World Food Day intended to draw the world's attention to the problem of food insecurity but the problem has become rather intense. Speth (1994) warned that if the problem is not urgently checked the number of people to face absolute poverty will increase from 300 million in the next 30 years from 1.2 to 1.5 billion by the year 2025. In Africa about 13 to 18 million people mostly children die as a result of hunger and malnutrition-related cases each year (40,000 people per day or 1,700 an hour).

The United Nations Millennium Project (2005) proposed an immediate plan to eliminate or at least halve global hunger by 2015 from 33 to 18% in the past 40 years. Yet 852 million people still go to bed hungry every night with some conditions being chronic or acutely malnourished. The statistics show 221 million people in India, China 142 million and sub-Saharan Africa 204 million and the figure is still increasing. Hunger is a global tragedy which requires many entomological efforts among others to eliminate. We recognize that political, economic and technological interventions are necessary too in the fight against hunger, however, entomologists have a key role to play. On the 5th of July, 2004, the UN Secretary-General addressed heads of African States and senior members of the International Community at a presidential level seminar on hunger in Addis Ababa, Ethiopia and described hunger as one of the most serious problems on earth and called for a uniquely African Green Revolution in the twenty-first century to spearhead the fight against hunger by addressing challenges of agriculture; healthcare; nutrition; adverse and unfair market conditions; weak infrastructure; and environmental degradation. Ayertey (2002) estimated that if a conservative loss figure of 10% due to storage insect pest was applied to major cereal crop produced worldwide, the total food loss to mankind was enough to sustain the whole Africa's population of 70 million people for 16 months. Adedire (2008) lauded the importance of insects in food security as veritable agents in ensuring food security as their pollinating activities directly affect fruits and crop production, and cross-pollination is required for fertility and plant vigour. About \$5-6 billion per annum have been estimated for non-honey bee pollination in the USA alone while the global pollination services rendered by insects may exceed \$100 billion annually by 2013 (Gullan and Cranstan, 2005). Lale (2010) while citing several reports conducted over 30 years on loss assessment conducted in the tropics arrived at 30 to 80% in cereals and Over 50% in legumes. Appert (1987) reported a 40% loss between harvest and

consumption incurred by farmers in the humid regions. While postharvest loss worldwide was put at 10 to 20% and 25 to 40% for tropics. In Nigeria, okra yield loss ranges from 26.7 to 45.6% (Anne, 1987) and seasonal monetary losses in tomatoes ranges from N1490.00 to N17, 555.00 p/ha (Lawal et al., 2011). Larger Grain Borer, *Prostephanus truncatus* (Horn) one of the insect pests accidentally introduced into Africa now poses a serious threat to food security in Africa. Ayertey (2002) reported total destruction of stored maize by *P. truncatus* in particular cob stored maize and cassava, which the insect can reduce to powder in few months. The major constraint to stored maize worldwide is the maize weevil, *Sitophilus zeamais* Motschulsky (Ofuya and Lale, 2001; Zakka, 2012; Nwosu, 2018). According to Adedire (2001), the larval stage is the most destructive stage of the insect. *Sitophilus zeamais* is the principal post-harvest insect pest of maize and infestation commences in the field as soon as the maize cobs began to turn yellow (Haines, 1991; Zakka et al., 2015). Both adult weevils and larvae feed on undamaged grains and frequently cause severe powdering and tainting, caking and moldy infestation which thus reduce their market values, rendering the product unfit for human consumption (Adedire, 2001; Ofuya et al., 2008). Enobakhare and Law-Ogbomo (2002) reported that partially damaged maize manifest loss in weight, poor marketability, quality deterioration and low viability. Obeng-Ofori (2008) and Zakka (2012) stated that the grain weevils are capable of establishing themselves on whole undamaged cereals (as a primary pest) and infested grains are perforated thus, allowing entry of secondary insect pests such as *Tribolium castaneum* which accentuate damage. Infestation by *S. zeamais* often commences in the field before harvest (Lale, 2002) and brought to stores with the harvested maize (Semple et al., 1992). Several works have shown the degree of infestation posed by *Callosobruchus maculatus* to stored legume in the tropics (Ofuya, 2001; Lale, 2002). These huge losses aggravate food insecurity status in Africa and increase hunger in the continent. *C. maculatus* is a principal pest of stored cowpea seeds (Ofuya, 2001) and is capable of infesting intact seeds in which immature stages develop. Substantial quantitative and qualitative losses in cowpea due to bruchid infestations have been reported and the major challenge facing farmers, traders and household consumers is post-harvest losses associated with arthropod pests, causing varying degree of hunger and entomologists have the capacity to solve this problem through research and innovation, pest control and extension services and active involvement in agriculture, especially precision farming.

RESPONSIBILITIES OF ENTOMOLOGISTS IN THE FIGHT AGAINST HUNGER

In what functional responsibilities are world entomologists expected to make global impact in the fight against hunger. Ogunwolu et al. (2015) provided the hint and they include:

- i. Developing methods for preventing the importation and spread of destructive insects whose activities have adverse effects on agriculture and the health of man.
- ii. Embarking on extensive investigations on the role of insects in agriculture, forestry, human and environmental health.
- iii. Accurately devising and implementing pest management programmes for both urban and agricultural locations.
- iv. Coordinate public awareness and education programmes targeted at reducing hunger in the world.
- v. Carrying out research on the evolution of insects, discovering and cataloguing new species and classifying and preparing publications that help to identify different insect species.
- vi. Involving in pest control services and extension entomology. These activities (when actively taken up by entomologists in different parts of the world) will reduce insect pest menace and invariably reduce hunger considerably by increasing agricultural productivity.

Conclusion

The major threats to attaining food security in order to prevent hunger are insect pests. Other factors of importance include climate change (which leads to drought and/or flood), disease epidemic, corruption in governance and internal and external crises such as insurgency. These factors have bad effects on agricultural production and on the economy of a country, ultimately causing hunger in the world. When a country suffers hunger, other countries may be affected because international economic relationships exist between countries of the world. To enhance food security and mitigate hunger prevalent in certain parts of the world, entomologists have developed strategies to control insect pests by applying a combination of methods already highlighted by Ayertey (2002), Okwakpam (2007), Umeozor (2009), Lale (2010) and Ajayi (2015). Such useful entomological strategies include quarantine or regulatory measures, cultural techniques, physical and mechanical measures, biotechnical control (to cover use of plant resistance and insecticidal plants), synthetic chemical and plant materials especially in stored products management, modified storage structures such as hermetic storage (that is, anaerobic technique), use of insect attractants and repellents, genetic techniques (such as sterile insect technique, translocation, conditional lethal genes, compound chromosomes), use of pheromones (that is, semiochemicals), biological techniques (use of natural enemies) and integrated pest

management (IPM) techniques. To effectively fight hunger in the world, entomologists must intensify research in all aspects of agriculture which shall culminate in successful control of insect pests and development of new technologies in order to increase food availability. Current data on the global hunger index showed that hunger and under-nutrition have declined over the long term. However, despite these improvements, certain factors including deep and persistent inequalities globally work against efforts to eliminate hunger and under-nutrition. To see a world without hunger by 2030, the task has to be undertaken holistically. In other words, governments, citizens, civil society organizations and the private sector must collaborate to invest, innovate and create a lasting remedy for hunger. The eradication of hunger is an incontrovertible necessity because if unmanaged, it has the capacity to slow progress in many others areas of development such as education and employment.

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